$Ce_{0.8}Gd_{0.2}O_{1.9}/VO_2$ memristive devices

Roman Korobko[1, 3], Yuichi Shigihara[1], Igor Lubomirsky[3] and Jennifer L M Rupp[1, 2]
[1]ETH Zurich, Switzerland
[2]Massachusetts Institute of Technology, USA
[3]Weizmann Institute of Science, Israel

Electrochemical resistive switches operating on ionic carriers, sometimes named memristors, may revolutionize the future electronics as the next generation building blocks of non-volatile memory and neuromorphic computing replacing electronically operated classic transistor structures. Despite an extensive research performed on solid oxide materials, th technology is still immature. erefore, the exploration in the direction of understanding the mechanisms and adaptation of novel materials systems is ongoing. In this presentation, we show a study of memristive properties of $Ce_{0.8}Gd_{0.2}O_{1.9}/VO_2$ thin lm system (Gd-doped ceria (GDC), and V^{4+} (vanadia). Ceria is a well-studied ionic conductor that tolerates high percentage of mobile oxygen vacancies. Vanadia, as VO_2 is famous for its metal-insulator transition, an ability to switch the resistance by several orders of magnitude by change of temperature, electromagnetic elds or mechanical strain beyond a su cient transition level. Furthermore, ceria is a wide bandgap (~3 eV) and vanadia is a narrow bandgap n-type semiconductor (0.7 eV) Combination of these materials in one device seems incompatible for the conventional electronic materials strategy due to the dissimilar electric/dielectric properties. We show that integrating both oxides in the double layer device yields to synergetic memristive results, which are uncharacteristic neither for GDC nor for VO_2 oxide constituents. It was experimentally found that the conduction and the resistive switching are governed by the mass transport kinetics, which is a function of the applied voltage, the electric eld and the voltage application rate. We suppose that the eld-induced transport of oxygen vacancies to and from the ceria-vanadia interface modi es the electrically variable energy barrier, which tunability is responsible for the enhanced memristance e ect.

Recent Publications:

1. V Venckute, S Kazlauskas, E Kazakevi ius, A Ke ionis, R Korobko and T Šalkus (2018) High frequency impedance spectroscopy study on Gd-doped CeO_2 thin lms. Ionics 24(4):1153-9.
2. R Schmitt, J Spring, R Korobko and J L M Rupp (2017) Design of oxygen vacancy con guration for memristive systems. ACS Nano 11:8881-8891.
3. N Yavo, A D Smith, O Yeheskel, S Cohen, R Korobko, E Wachtel, P R Slater and I Lubomirsky (2016) Large nonclassica electrostriction in (Y, Nb)-stabilized -Bi_2O_3. Adv. Funct. Mater. 26:1138-1142.
4. G Lazovski, O Kraynis, R Korobko, E Wachtel and I Lubomirsky (2015) Optical investigation of oxygen di usion in thin lms of Gd-doped ceria. Solid State Ion 227:30-37.
5. R Korobko, A Lerner, Y Li, E Wachtel, A I Frenkel and I Lubomirsky (2015) In-situ extended x-ray absorption ne structure study of electrostriction in Gd doped ceria. Appl. Phys. Lett. 106(4):042904.

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